Space Weather Technical Forecast

Issued on Monday, 20 June 2022 at 01:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Daily Chance of an isolated M-class flare. Chance of Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with background X-ray flux recorded at GOES16 steady on the boundary between B and C class. Occasional small X-ray flares were observed, the largest being a C4 originating from AR3038, now approaching the central meridian in the north, peaking at 19/2009 UTC. There are six other regions on the visible disc.

A large filament in the northwestern quadrant is showing sings of movement late in the period. A couple of CMEs were observed leaving the sun but none of these are considered to be Earth-directed.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, was relatively steady during the first half of the period at around 580-600 km/s, presumably under the influence of the HSS originating from CH92/+, before slowly declining during the second half, currently around 540 km/s. Density was very steady and around 9 ppcc. The IMF was within normal background levels between 5 and 7nT, with weak variations of +/-5nT in its north-south component. The phi angle was largely positive (away from the Sun) but became negative (towards the Sun) for a time between 19/1200-1400 UTC. The net result of the above solar wind measures was Quiet to Unsettled, albeit with an Active period recorded between 19/0000-0300 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) measured by GOES16 remained at background levels through the period. Electron flux (greater than 2MeV) was generally at Moderate to High levels in the period, with a peak of 2950pfu observed at GOES16 at 19/1735UTC. The corresponding 24-hour integrated electron fluence showed a rising trend, with a value of 1.03e8 integrated pfu observed at 20/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low, with a daily chance of an isolated M-class flare and slight chance of an X-flare.

Solar Wind / Geomagnetic Activity: No CMEs feature in the forecast. Elevated solar winds are expected to slowly decline on Day 1 but may become elevated or perhaps strong on Day 2 under the influence of a small coronal hole, followed by another slow decline on Days 3 and 4. Geomagnetic activity should remain largely Quiet, but Quiet to Unsettled with a chance of an Active interval or even a very slight chance of a G1/Minor storm on Day 2 (21st).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10 MeV) is expected to be at Background levels during the period, but with a daily Slight Chance of an S1 or greater event occurring, due to the presence of a couple of relatively large and complex regions.

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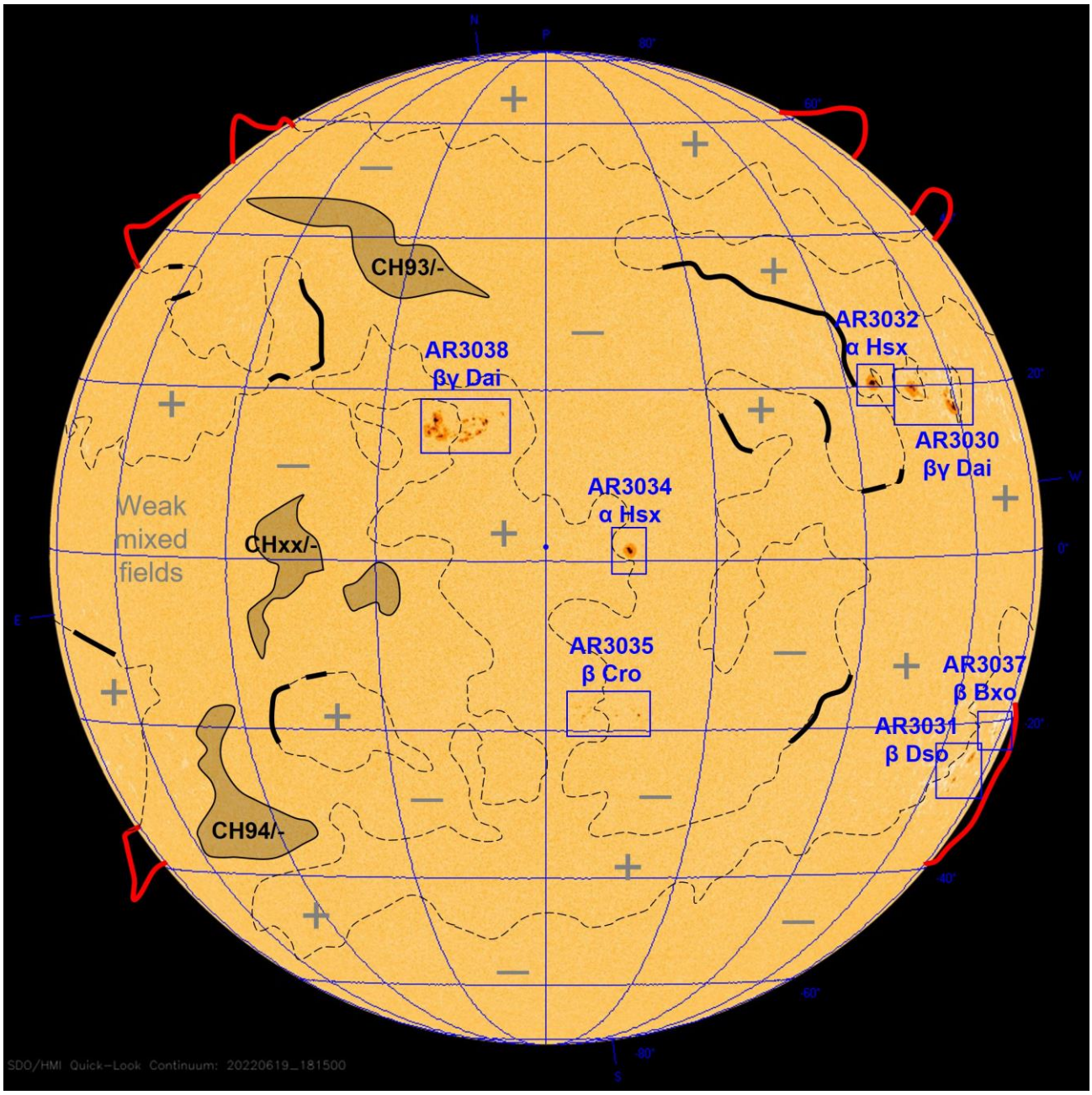
High energy electron flux (greater than 2 MeV) is expected to fluctuate between Moderate to High levels on most days in response to the recent HSS. The 24-hour integrated fluence is likely to breach the Active threshold on most days, the risk considered greater on Day 1.

Figure 1. Solar Analysis Valid 19/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No CMEs feature in the forecast.

The Earth is now under the waning influence of CH92/+, a feature that is no longer visible, with solar winds expected to gradually decline over the following days. However another coronal hole, that was briefly seen facing the Earth on the 17th, may enhance the solar winds on Day 2 (21st). This feature is no longer visible but data obtained from STEREO A MAG and PLASTIC show the solar wind rising to elevated or even strong levels on the 19th, in association with a positive phi angle. Confidence is low but this would suggest a possible enhancement to the geomagnetic activity, although this should be limited considering the magnetic field remained weak with no prolonged periods of negative Bz during this time.

The next coronal hole likely to affect the solar wind is CH93/+, currently approaching the central meridian. It is a recurrent feature but appears to be further east compared to the previous rotation. As such, the persistence model is considered to increase the speed too early, the HSS from this feature more likely to arrive at Earth on the 24th, thus beyond the scope of this forecast.

All things considered, geomagnetic activity should remain largely Quiet, but Quiet to Unsettled with a chance of an Active interval or even a very slight chance of a G1/Minor storm on Day 2 (21st).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

NIL

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Figure 2: STEREO A Mag & Plastic data showing a solar wind enhancement around the 19th, which could translate to something similar on the 21st at Earth.

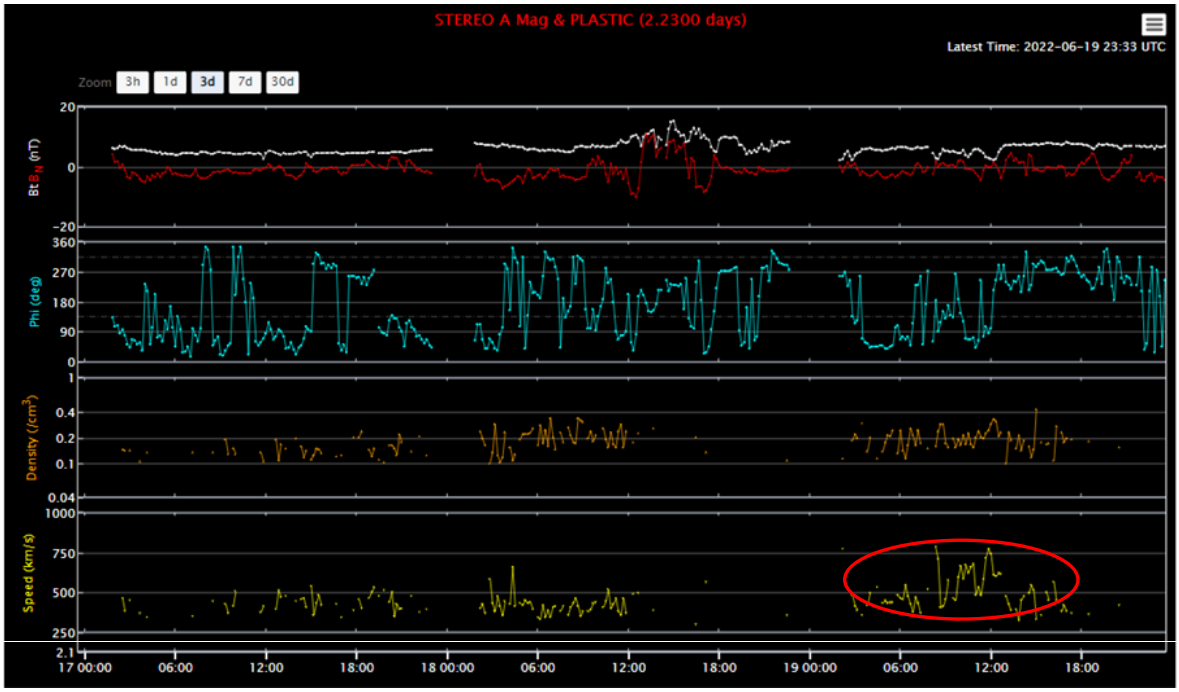
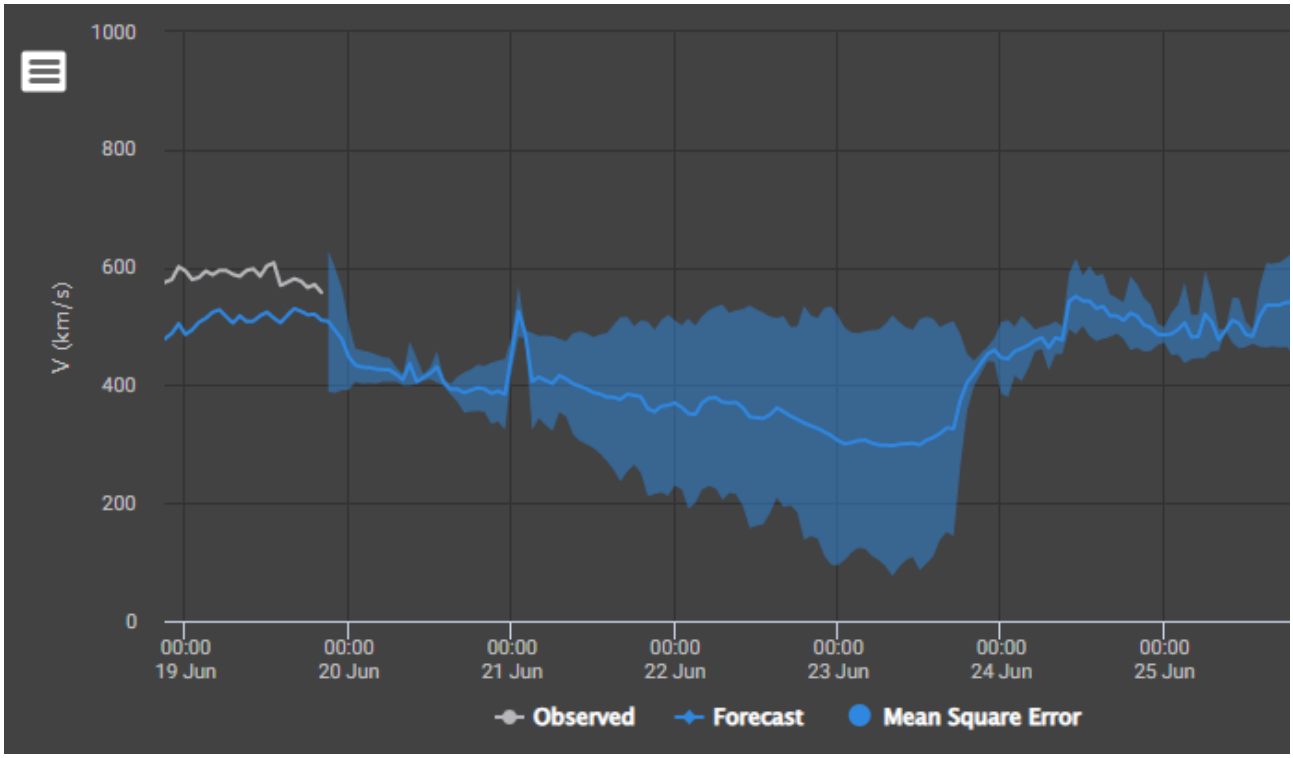


Figure 3: Met Office SWPM showing an enhancement of the solar wind speed at the end of the 23rd, considered too early.



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Radio Blackouts - X-Ray Flares:
There are presently seven numbered sunspot regions on the visible disc, AR3033 and AR3039 having now faded to plage regions. The largest and most complex regions are currently AR3030, in the northwest quadrant, and AR3038, now approaching the central meridian in the north. Both of these regions are moderately large, developing and were analysed as Dai/Beta-Gamma. That said, AR3038 is displaying a more rapid growth, with the development of several tiny spots in its central part, some of which seem to contain a rudimentary penumbra. AR3032, AR3034 and AR3035 are now mature and not showing much in terms of development or activity. AR3031, in the southwest, continues to reduce in size, with its trailing spots fading. AR3037 is now approaching the southwest limb and has become difficult to analyse but remains a simple Bxo group.

Solar activity was Low, with occasional C-class flares originating from AR3031 and AR3038. Solar activity is likely to continue at Low levels with a slight daily chance of M-class flare, most likely from AR3030 or AR3038.

The large filament on the northwest quadrant is showing signs of instability and will need to be monitored for any lift-off. Some bright flux regions are also visible on STEREO A EUVI195 imagery, around 120 degrees East, suggesting the presence of sunspots regions. These could potentially emerge from the far side over the following days, hence the reason for maintaining the probabilities in their current state.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 4: Latest GOES X-Ray flux showing very low levels

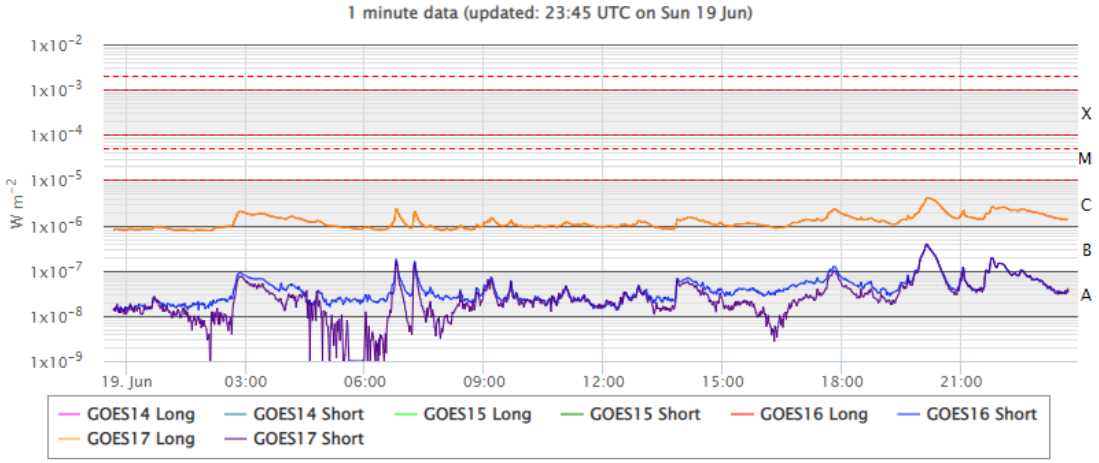

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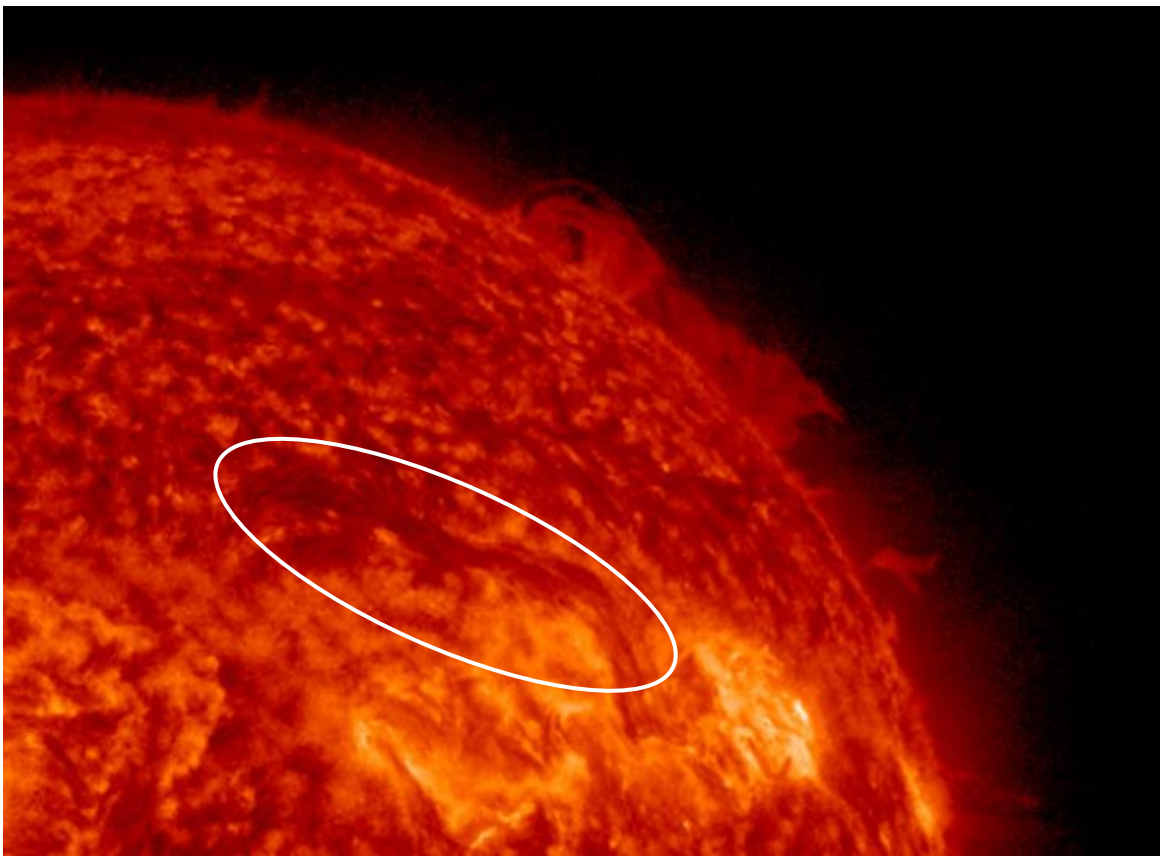
Figure 5: Latest SDO/AIA 304 image, showing a large and unstable looking filament over the northwestern quadrant.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at background levels and is expected to remain at this level through the period. However, there is a slight chance of an S1 or greater event in the period. This risk averages to around 5% daily, due to the well spread nature of the larger regions on the disc, and any departing regions should be reinforced by the westward transit of the remaining spots.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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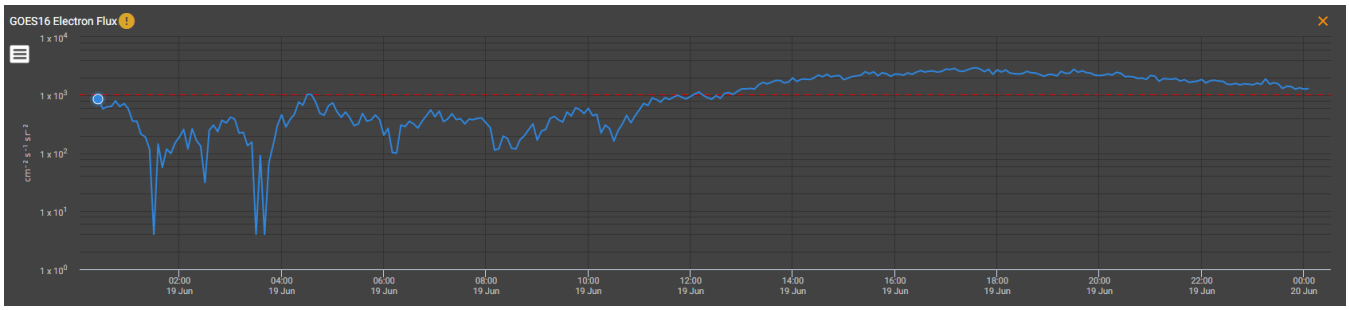
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV), as observed by GOES16, rose to high levels, peaking at 2950ppcc at 19/1735 UTC, the radiations belts becoming filled following the HSS originating from a couple of coronal holes. This pattern should continue over the following days, the electron flux becoming high during the diurnal peak, but the hypothetical arrival of another HSS on Day 2 may complicate the picture. The electron flux may become suppressed for a time in response to the geomagnetic enhancement but should recover and exceed high levels on Days 3 and 4. However confidence is low.

The 24-hour integrated fluence is likely to breach the Active threshold on most days, the risk considered greater on Day 1. The latest MOSWOC REFM was not expecting a rise before the end of Day 1 (24 hours later) and is unlikely to foresee the arrival of the hypothetical HSS on Day 2. As such, it is not considered to offer good guidance.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	60	50	50	50
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 6: Latest GOES Electron Flux levels



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